

Variations in the External Auditory Canal of 185 Adult Individuals: A Clinico-Morphological Study

Rajamani Santhosh Kumar*, K R Jothi Kumar**, D Saravana Bhavan***, A Anandaraj#

* Assistant Professor, Department of ENT, Sri Lakshmi Narayana Institute of Medical Sciences, Ossudu, Puducherry
 ** Professor and HOD, Department of ENT, Sri Lakshmi Narayana Institute of Medical Sciences, Ossudu, Puducherry
 *** House Surgeon, Sri Lakshmi Narayana Institute of Medical Sciences, Ossudu, Puducherry
 # House Surgeon, Sri Lakshmi Narayana Institute of Medical Sciences, Ossudu, Puducherry

Abstract- There is number of variations in the morphology of the External Auditory Canal which influence the ability to examine the canal and also play a role in pathogenesis of many Ear diseases. Broadly the aperture of the External Auditory canal is classified into “Narrow” and “Broad” canals. The natural self cleansing ability of the Ear canal may be affected in narrow canals, which could predispose to pathology. This study aims to classify and highlight the variations in ear canal anatomy in a cohort of 185 young adults.

Index Terms- External auditory canal, Anatomy, Aperture, Opening, Narrow, Broad, Tortuous

I. INTRODUCTION

The External auditory canal is a blind skin lined sac. The canal is developed from recanalization of the Meatal plate in embryo. This recanalization process is variable and may produce variations in the morphology of the External Auditory canal. This study attempts to classify the morphology of External auditory canal in a subset of 185 normal disease free adult individuals.

II. MATERIALS AND METHODS

A total of 207 normal healthy persons belonging to the age group 19 to 25 years were chosen.




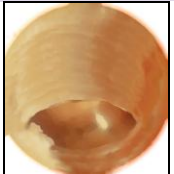
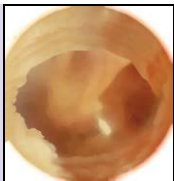
Inclusion criteria

1. Average adult male or female of age between 19 to 25 years
2. No previous history of any ear complaints like ear discharge, hard of hearing, swelling in the ear
3. Consenting to be included in the study
4. Subjects with wax in both ears were excluded from this study.

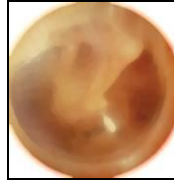
Grading of the External Auditory canal

The following table represents Morphological Grading of the External Auditory canal, which was created for the purpose of this study.

Table 1: Morphological (Working) classification of the External Auditory Canal

Tentative SLIMS Grading	Appearance on Headlight Torch examination	Classification in Broad Terminology	Schematic Image
0	No part of canal seen. Soft tissue filling up the External Auditory canal	Ear canal – Atresia	
1	Outer one third – hairs only seen or no aperture seen	Narrow	
2	Outer one-third Aperture of ear canal seen beyond the hairs	Narrow	
3	Inner two-third of canal seen, and/or part of Annulus of Tympanic membrane seen	Intermediate	
4	Part of Pars Tensa and handle of Malleus is seen with light reflex, Pars flaccid is not seen	Broad	

5 Tympanic membrane fully seen. Handle of Malleus, Light reflex and pars flaccida easily visible. Broad



All grading was done with an immediate appearance on Headlight or Torch, with minimum pull upwards, backwards and laterally. Outer one third of External Auditory canal was identified by the presence of hairs and thicker skin. Inner one third was identified by thinner skin and absence of hairs. Otoscope or speculum or Endoscope was not used in this study as these magnify and distort the natural orientation and anatomy of the Ear canal which is the highlight of this paper.

III OBSERVATIONS

A total of 22 subjects were excluded from the study. 11 subjects, (3 males and 8 females) had significant variations in the morphology of the canal between the two ears i.e. more than 2 grades. This was deemed due to some pathology like previous Otitis externa or Scarification etc hence were excluded from our study.

In addition 11 subjects, (3 males and 8 females) had bilateral asymptomatic wax occluding both the ear canals, which precluded the grading of such canals. In our study incidence of bilateral wax was thus (11 out of 207 examined) 5.3% of normal population. Wax is more common in females than males. This shows a value less than previous studies which rate wax from 7 to 35 percentages but unlike our research, the given referenced studies includes Pediatric population (Ref 1). This perhaps, explains the lower percentage incidence which was found in our study.

The outcomes of the study are depicted in the graphs that follow.

Percentage incidence of various types

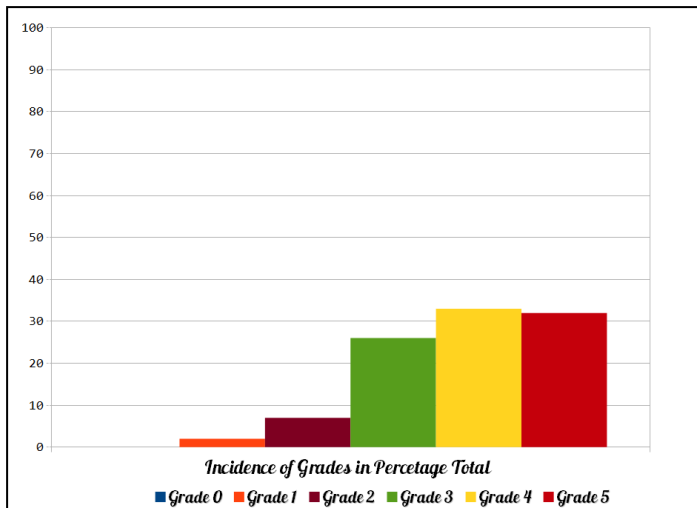


Figure 1: Percentage incidence of various morphological grades of External Auditory canals in Normal individuals

As it can be inferred from graph above that the most common Grade of External Auditory canal was Grade 4 (Broad). This was closely followed by Grade 5 (Broad). Together these two broad types were found in 65% of the individuals. Intermediate grade 3 was found in 26% of individuals, while Narrow variants are rare in occurrences, with a least value of 9%.

Sex wise distribution of types

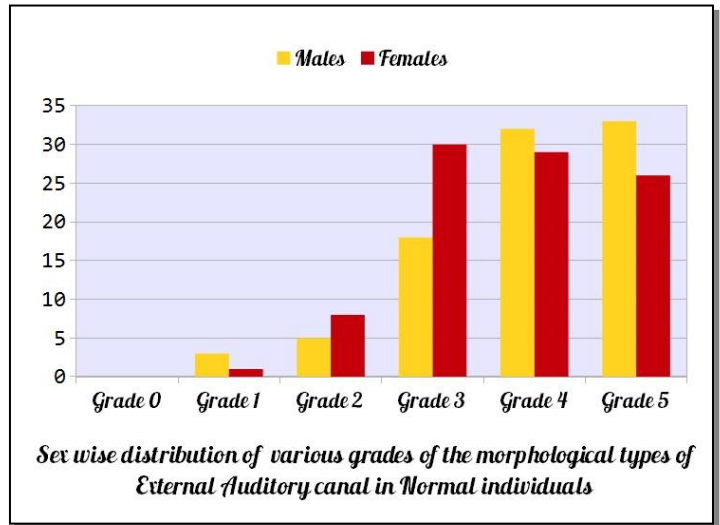


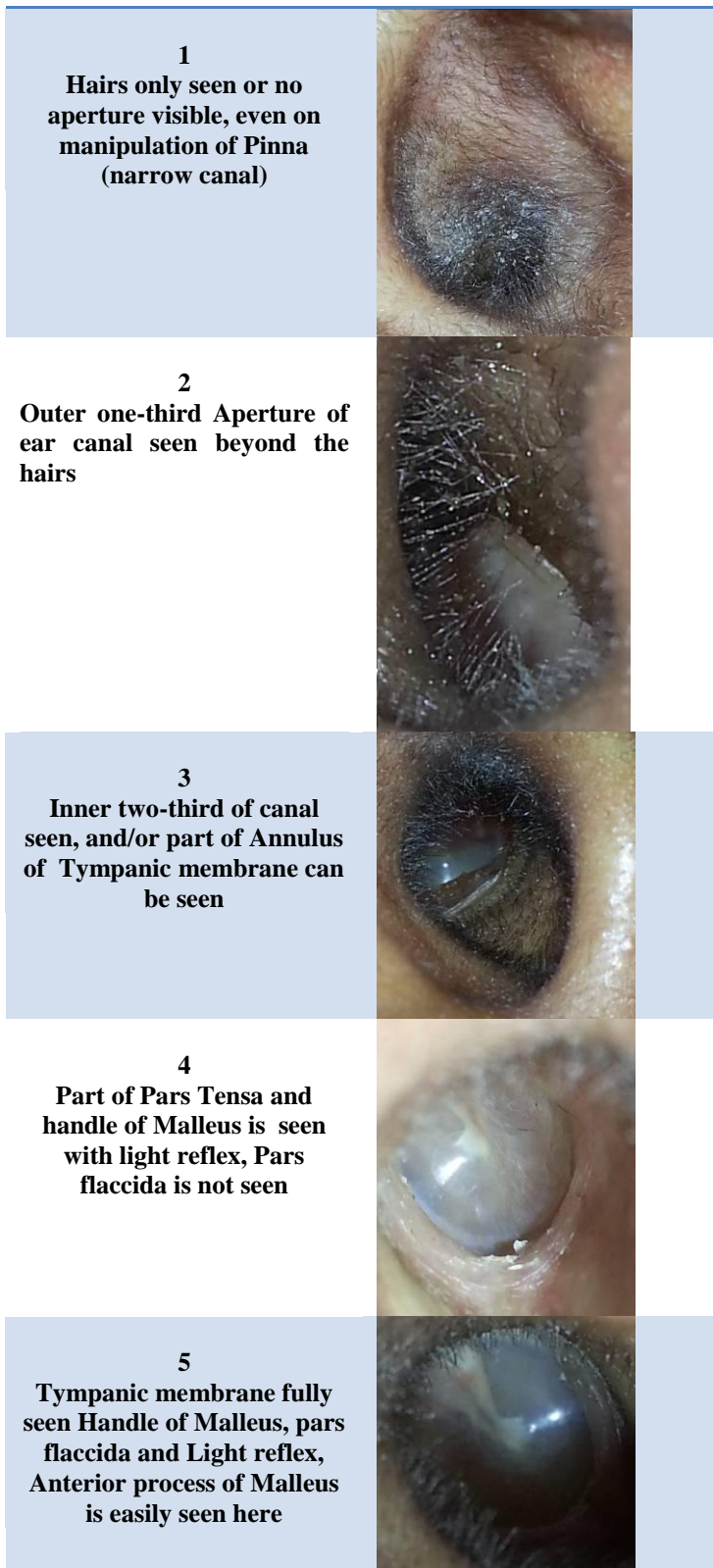
Figure 2: Sex wise incidence of the various grades of the morphological types of External Auditory canal in Normal individuals

It can be inferred from the graph given above, that majority of the External Auditory canals in both males and females are broad, 65% (120/185). Grade 3 Intermediate canal seems to be significantly more common in females in comparison to males.

Narrow canals are quite rare per se (only 9%) and Grade 2 narrow canals seem to be more common in females, though the number of samples in these two categories is too small for a significant conclusion (n < 30).

Table 2: Classification of the External Auditory Canal – Photographic illustration of the types

Grade and explanation	Clinical Photograph
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External Auditory canal develops from the groove of first Branchial arch. This groove deepens and meets the Tubo-tympanic recess of the Endoderm and Mesoderm contributes from the sides. The plate of tissue thus formed is called a Meatal plug. This recanalizes and the External Auditory canal is formed. This in-utero recanalization process has a variable outcome and may produce a variation in the lumen of the External Auditory canal. Plus during the course of development, the External Auditory canal descends downward creating further angulations of the canal ^(Ref 3).

Tympanic bone with its soft tissue cover forms the External Auditory canal. Tympanic bone connects to the mastoid part via tympanomastoid sutures and with squamous part via the tympanosquamous suture line. Spinous process is projection of this suture line into the ear canal. Tympanic bone forms the posterior part of Glenoid fossa. Anterior Glenoid fossa encroaches on the lumen of the External Auditory canal and creates a variable degree of narrowing of the ear canal ^(Ref 8). Tympanic bone is major contributor to shape and orientation of the External Auditory canal ^(Ref 15).

External Auditory canal is a skin lined blind bag. Natural skin of the External Auditory canal has tendency to migrate outward as it matures. Wax or Cerumen rides on the tip of the hairs to migrate outwards ^(Ref 6). This causes self cleansing of the canal and prevents the ear from completely filling up with the skin and debris ^(Ref 10).

External Auditory canal consists of outer one-third made of cartilage and an inner two-thirds made of bone. There are no Rete pegs (dermal papillae) hence it closely attaches to the outer cartilaginous and inner bony part of the External Auditory canal. The subcutaneous tissue of the cartilaginous part is thick and contributes the bulk of the External Auditory canal. External Auditory canal has a tortuous "S" shaped course in which it first travels inward, anterior and superiorly (*pars externa*), then inwards, posterior and superiorly (*pars media*) and then finally, anterior and inferiorly (*pars interna*) ^(Ref 5). In order to visualize the Ear canal one has to pull upwards, backwards ^(Ref 6).

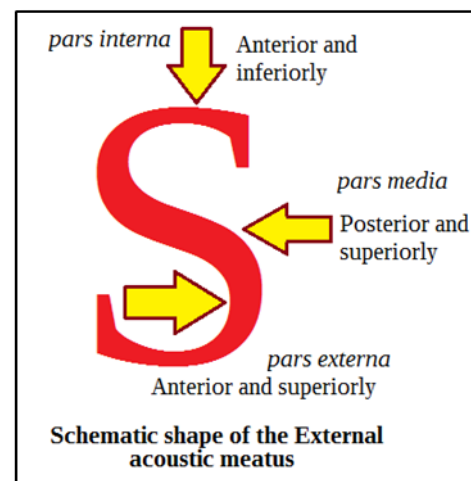


Figure 3: Schematic shape of the External Auditory canal

IV Discussion

Relevant anatomy and physiology of the External Auditory canal

Hairs are present only in the outer one-third of the External Auditory Canal and their absence helps to distinguish the bony from cartilage part of the External auditory canal. This difference is capitalized in our classification of types of the External Auditory canal.

Blood Supply to External Auditory canal ^(Ref 14)

Cartilaginous part derives blood supply from: 1. Superficial temporal artery and 2. Posterior auricular artery, bony part derives blood supply from Deep auricular branch of the Maxillary artery. Lymphatics drain into the Preauricular and Postauricular Lymph nodes.

This study *in principio* attempts to classify aperture, orientation and soft tissue cover thickness of the External Auditory canal.

Pathological conditions related to morphology Canal wall

The angulation of the Ear canal is related to a few pathological condition of the Temporal bone. For instance, in Keratosis obturans there is impaired migration of the External Auditory canal skin and subsequent impaction and widening of the bony part of the canal ^(Ref 7). This condition is usually bilateral strengthening our theory that it is an abnormal anatomy of the External Auditory canal, which predisposes to the development of this disease. Narrow recesses in the ear canal may lead to entrapment of the skin in the posterior-inferior portion of the bony external auditory canal and Cholesteatoma formation ^(Ref 9).

Likewise, foreign body impaction is more common in narrow ears. Otitis externa and Otomycosis occurs due to excessive sweating and accumulation of moisture which is more common in narrow canals (type 1 and 2). In Malignant Otitis externa, the initial infection is confined to the skin and soft tissues of the ear canal and further progress to skull base may be determined by the thickness and orientation of the External Auditory Canal ^(Ref 11).

External auditory Exostosis occurs frequently in swimmers, as the splashing of cold water inside the canal causes development of bony spicules. ^(Ref 12) Exostosis may be related to a broad canal wall (type 4 or 5) which would predispose to development of this condition.

Benign necrotizing Otitis externa is necrosis of the skin and superficial bone may be more common in broad ears with a thinner soft tissue cover (grade 4 or 5) ^(Ref 13).

Clinical uses of this classification

Endaural incision and Intra-canal procedures need a broad ear canal, as the whole instrumentation has to be done into the canal ^(Ref 2). Our study will help the clinicians in classifying the cases fit for Endaural versus post-auricular access methods. Types 5, 4 and 3 would be more suited for the Endaural procedures.

V Conclusion

There are variations in canalization of the embryological Meatal plug, resulting in a variety of morphological types of External Auditory canals. Most common types are Grade 4 and 5 Broad ear canals. Asymptomatic bilateral wax was found in 5.3% of the total subjects. There seems to be a relationship between type of ear canal and diseases of External ear. This association needs to be elucidated by further studies correlating External Auditory canal grades we have propounded, with actual disease patterns.

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AUTHORS

Rajamani Santhosh Kumar M.S (ENT), D.N.B(E.N.T), D.P.H
(Corresponding principle- author)
Assistant Professor, Department of ENT, Sri Lakshmi Narayana
Institute of Medical Sciences, Ossudu, Puducherry 605 502
Contact no: 09952771921
Email: Minerva.santh@gmail.com

K R Jothi Kumar M.S (E.N.T), D.L.O
Professor and HOD, Department of ENT , Sri Lakshmi Narayana
Institute of Medical Sciences, Ossudu, Puducherry 605 502

D Saravana Bhavan M.B.B.S
House Surgeon, Sri Lakshmi Narayana Institute of Medical Sciences,
Ossudu, Puducherry 605 502

A Anandaraj M.B.B.S
House Surgeon, Sri Lakshmi Narayana Institute of Medical Sciences,
Ossudu, Puducherry 605 502
